

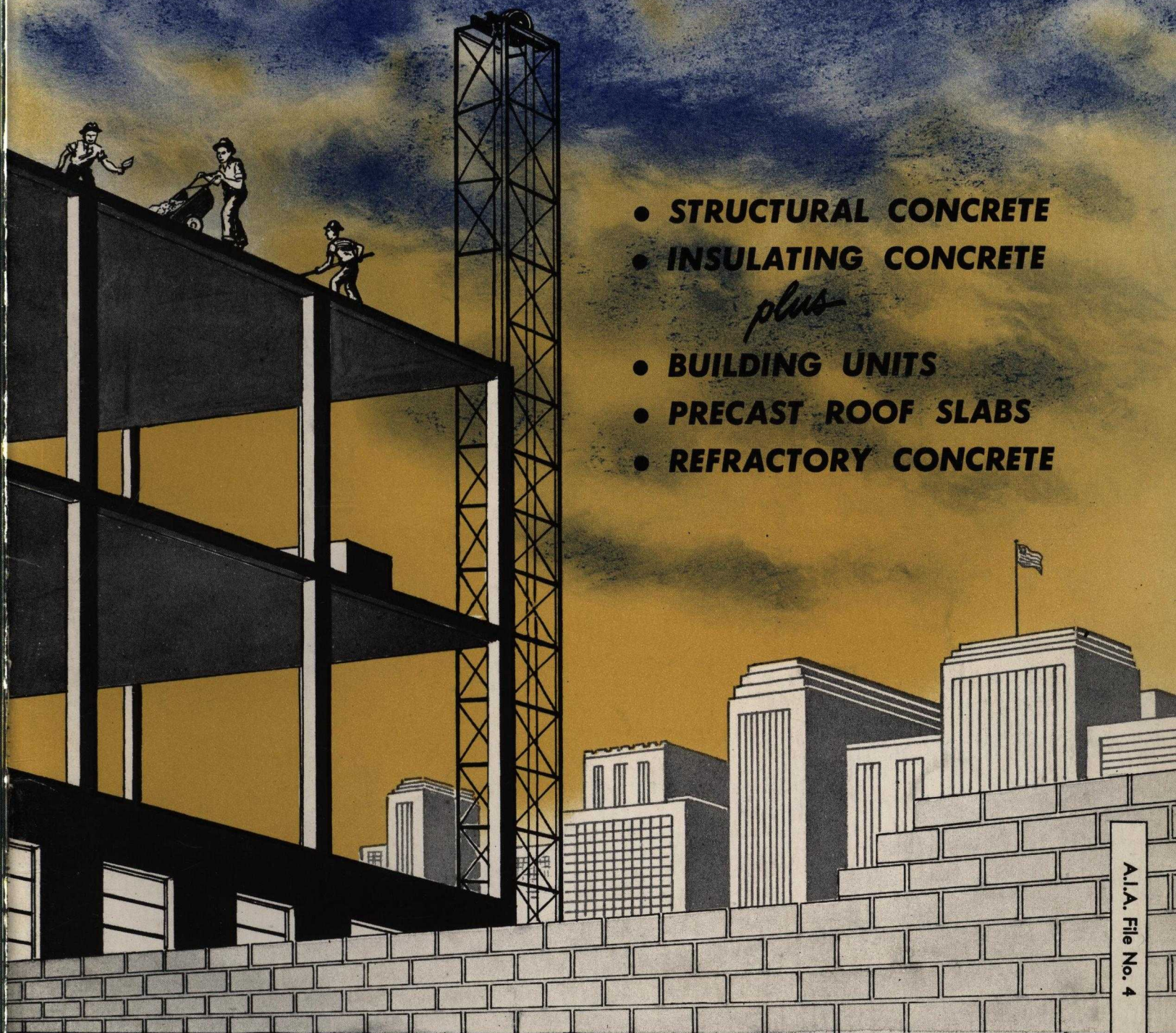
Haydite

THE *"Original"* LIGHTWEIGHT AGGREGATE

- **STRUCTURAL CONCRETE**
- **INSULATING CONCRETE**

plus

- **BUILDING UNITS**
- **PRECAST ROOF SLABS**
- **REFRACTORY CONCRETE**



HYDRAULIC-PRESS BRICK COMPANY

ST. LOUIS, MO.

SOUTH PARK, OHIO

PRESENTING



Hydraulic Haydite DETAIL DATA MANUAL for Design Engineers and Architects

Preface to Progress	3
Manufacture of Haydite	4
Properties of the Aggregate	4-5
Structural Concrete	6-9
Mix Design	6
Physical Properties	7-8
Strength-Weight Ratio	9
Fire Resistance	9
Insulating Concrete	10-12
Mix Design	10
Physical Properties	10-11
Roof Insulation	12
Concrete Floor Insulation	12
Multiple Story Construction	13
Additional Applications	14-15
Haydite Building Units	14
Precast Roof Slabs	14
Refractory Concrete	15
Products - Sales Offices - Plants	16



HYDRAULIC-PRESS BRICK COMPANY

705 Olive Street
St. Louis, Mo.

South Park
Ohio



PREFACE TO PROGRESS

HAYDITE, the Original Lightweight Aggregate, was developed some three decades ago specifically for use in lightweight concrete.

Since the beginning of commercial production, extensive tests have been carried on continuously in commercial laboratories and at various universities; among them Ohio State University, Armour Institute, University of Illinois, Washington University in St. Louis, University of Michigan, University of Wyoming and University of Wisconsin. Also several Government Agencies—including the United States Bureau of Public Roads, the National Bureau of Standards and the Bureau of Reclamation—have tested Haydite thereby enabling the Haydite industry to keep abreast of all progressive developments in concrete-making.

In all tests, without exception, Haydite aggregate satisfactorily met all the essential requirements desirable in concrete: namely—workability, economy, strength, durability.

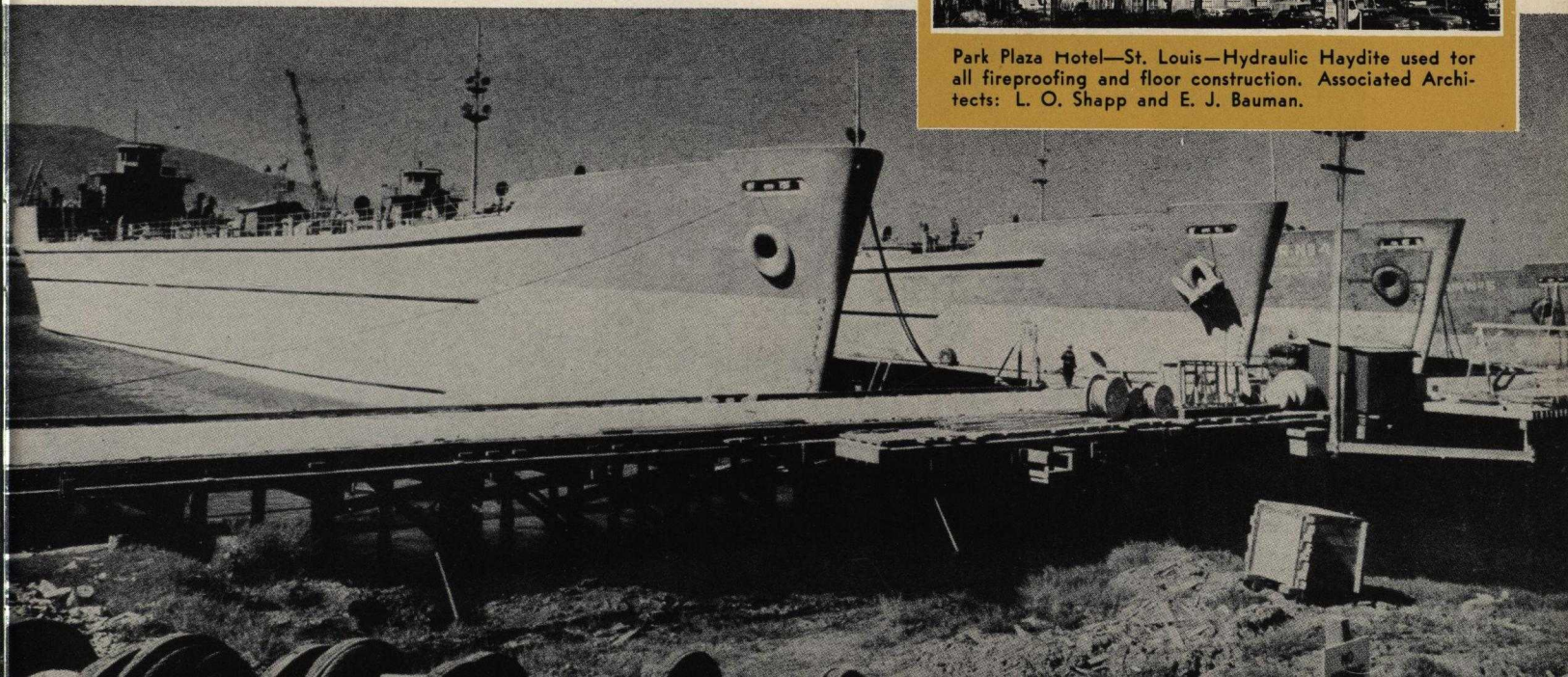
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A notable example illustrating the use of Haydite aggregate occurred during World War II—the construction of concrete sea-going barges for the Government. Hull and deck specifications called for concrete with a structural strength of 6,000 pounds per square inch in combination with a very essential requirement of low weight. The high strength and low weight of Hydraulic Haydite concrete made it the first choice for all the barges built at Savannah, Georgia.

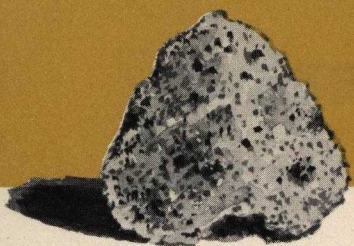
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Park Plaza Hotel—St. Louis—Hydraulic Haydite used for all fireproofing and floor construction. Associated Architects: L. O. Shapp and E. J. Bauman.



Haydite... MANUFACTURE



MANUFACTURE

Haydite aggregate is manufactured from high grade shales and clays which contain the constituents necessary for expansion at high temperatures. The raw shale or clay is crushed to a workable size, then fed into rotary kilns of substantially the type used for the manufacture of Portland cement.

Through proper control of the temperatures (which are in excess of 2200° F.) the raw material is brought to a state of incipient fusion at the same time gases are being evolved throughout the mass. *These gases are formed from minerals naturally occurring within the clay or shale.* The result is a product comprised of a mass of thin walled cells or pockets (vesicular structure) caused by the gas expansion.

After being discharged from the kiln the resultant clinker is allowed to cool slowly. This clinker is then crushed and screened to properly balanced gradings for the various uses.

PROPERTIES OF THE AGGREGATE

CELLULAR STRUCTURE

Controlled manufacturing process produces an inert lightweight material of cellular structure. The expansion is so complete that even the finest particles of the burned material are composed of a series of tiny cells with vitrified walls. Magnification shows this to be an ideal cellular structure.

It is this cellular structure that gives Haydite its *superior heat and sound insulating qualities.* Having been burned at a temperature in excess of 2200° F., Haydite has *no combustionable content* and is *chemically inert.*

SPECIFIC GRAVITY

Bulk specific gravity	-	-	-	-	1.65
Apparent specific gravity	-	-	-	-	1.74

ABSORPTION

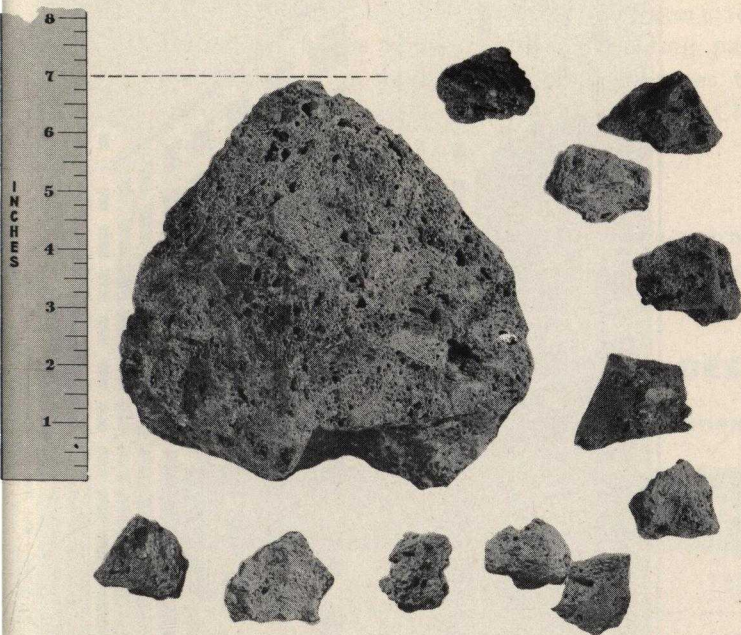
Absorption of aggregate is 7% by weight. The excess moisture is effective as mixing water.

WEIGHT

Haydite aggregate, as shipped, weighs 1450 to 1550 pounds per cubic yard in the loose, damp condition.



... PHYSICAL PROPERTIES



GRADING

"BX" size Haydite, passing the $\frac{1}{2}$ -inch screen and ranging to dust, is used for structural concrete and fill concrete. This is a combined grading of coarse and fine aggregate properly proportioned for job requirements.

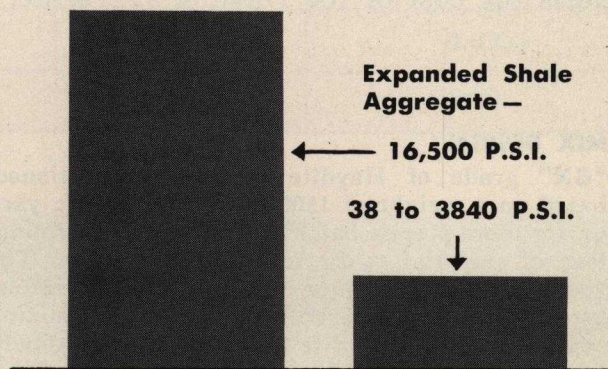
"AA" size Haydite, passing the four mesh screen and ranging to dust, is used for Guniting work, topping and other special applications.

TYPICAL CHEMICAL ANALYSIS

Silica	- - - -	(SiO ₂)	- - -	59.40%
Ferric Oxide	- - - -	(Fe ₂ O ₃)	- - -	7.71
Alumina	- - - -	(Al ₂ O ₃)	- - -	24.69
Calcium Oxide	- - - -	(CaO)	- - -	.40
Magnesium Oxide	- - - -	(MgO)	- - -	2.28
Alkalis	- - - -	(As NA ₂ O)	- - -	2.79
Sulphur Dioxide	- - - -	(SO ₂)	- - -	.60
Loss on Ignition	- - - -	- - -	- - -	1.90

SOUNDNESS TEST

Haydite aggregate complies fully with the soundness test A.S.T.M. C-88.



CRUSHING STRENGTH

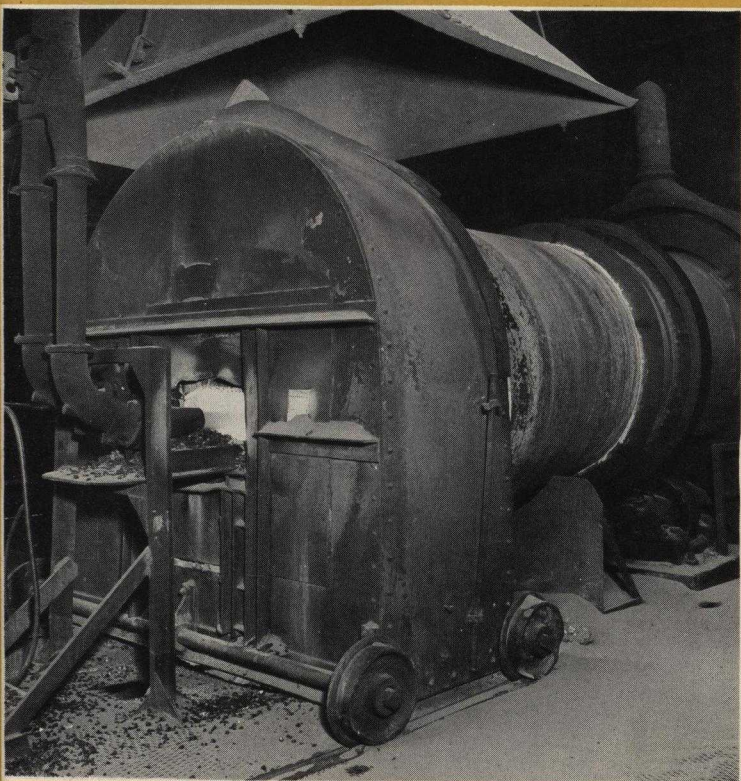
Tests performed by the National Bureau of Standards* showed the crushing strength of expanded shale aggregate (Haydite is the original expanded shale aggregate) to be far superior to any other lightweight aggregate tested. These tests show the crushing strength of expanded shale aggregate to be

16,500 p.s.i. at 2-inch compaction.

Crushing strengths of other commercially available lightweight aggregates range from

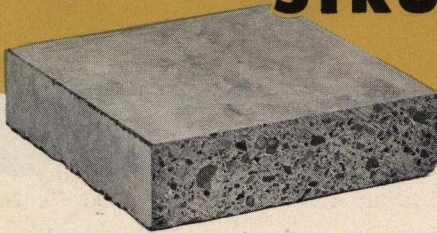
38 to 3840 p.s.i. at 2-inch compaction.

*Lightweight Aggregate Concretes, Housing and Home Finance Agency, Washington, D. C., August, 1949.



Around the clock operation is carried on at plants in St. Louis and South Park (Cleveland), Ohio. At the left is a photo-panorama of the South Park plant, and above is pictured the "firing front" of one of the Rotary Kilns in which Hydraulic Haydite is scientifically produced at temperatures in excess of 2200° F.

STRUCTURAL CONCRETE produced



Haydite has been used extensively in the construction of both reinforced concrete and structural steel frame buildings for 20 years. Nearly every city over 200,000 population in the United States and southern Canada has some Haydite concrete construction.

Haydite structural concrete is one-third lighter than concrete made of sand, gravel, and/or crushed rock of the same strength. *Substantial reductions in dead loads are thus made possible with corresponding reductions in steel requirements. In structures of equal height, it permits a decrease in the cost of supporting trusses, columns, footings or other substructures.* There are many instances where the savings in cost of structures due to reduction in dead load resulting from the use of Haydite aggregate, has amounted to more than three times the cost of the Haydite aggregate.

MIX DESIGN

"BX" grade of Haydite may be proportioned, based on a weight of 1500 pounds per cubic yard or, for more precise batching, an actual determination of material to be used can be made. The absorption of aggregate is 7% by weight. Moisture in excess of 7% will be effective as mixing water. Because Haydite absorbs moisture slowly, pre-wetting of dry aggregate in advance of mixing is recommended.



Halle Brothers Company—Cleveland, Ohio—
9,000 cubic yards Hydraulic Haydite Structural
Concrete for all 10 floors. Architects: Walker and
Weeks; General Contractor: Sam W. Emerson Co.

The following quantities for one cubic yard of concrete in place are recommended in designing mixes. With careful batching and control of water, strengths in excess of those shown will be obtained. Concrete placed with vibration permits a lower water content with corresponding strength increase according to water-cement ratio curves.

MIX	MIXING WATER		HAYDITE		WEIGHT	COMPRESSIVE STRENGTH	
	Gallons	CEMENT	Cu. Yds. Per		Pounds		
	Per Sack	Sacks	Cu. Yd. Concrete		Per Cubic	Pounds Per Sq. In.	
	Cement	Per Cu. Yd.	in Place		Foot	7 Days	28 Days
1-3	5.5	9.0	1.00		102	2,400	4,000+
1-3½	6.0	8.0	1.05		101	2,100	3,500+
1-4	7.0	7.0	1.10		100	1,800	3,000+
1-5	8.0	6.0	1.10		98	1,500	2,500+

with *time-tested* Hydraulic Haydite

COMPRESSIVE STRENGTH

Design strengths are given in the Page 6 Chart on mix design. Results of actual laboratory tests (based on mixes shown on the preceding page) are available on request. Testing indicates that compressive strengths given in the Page 6 Chart are conservative.

MODULUS OF ELASTICITY

Modulus of elasticity of Haydite concrete averages about 55% of that of gravel concrete. In using

the A.C.I. Building Code value of 1,000 f'_c for modulus of elasticity of gravel concrete as a basis, the modulus for Haydite concrete is 550 f'_c —(f'_c = Compressive strength of concrete at twenty-eight days).

SHEAR AND BOND


Working stresses commonly applied to gravel concrete for bond and diagonal tension may be used with Haydite concrete.

DESIGN VALUES

Balanced Reinforcement, f'_s = 20,000 P.S.I.; f_c = 0.45 f'_c

f'_c	2000	2500	3000	3750
f_c	900	1125	1350	1688
n	27	21.8	18.2	14.5
k	0.548	0.548	0.548	0.548
j	0.817	0.817	0.817	0.817
p	0.0123	0.0154	0.0185	0.0231
K	202	252	302	378

7



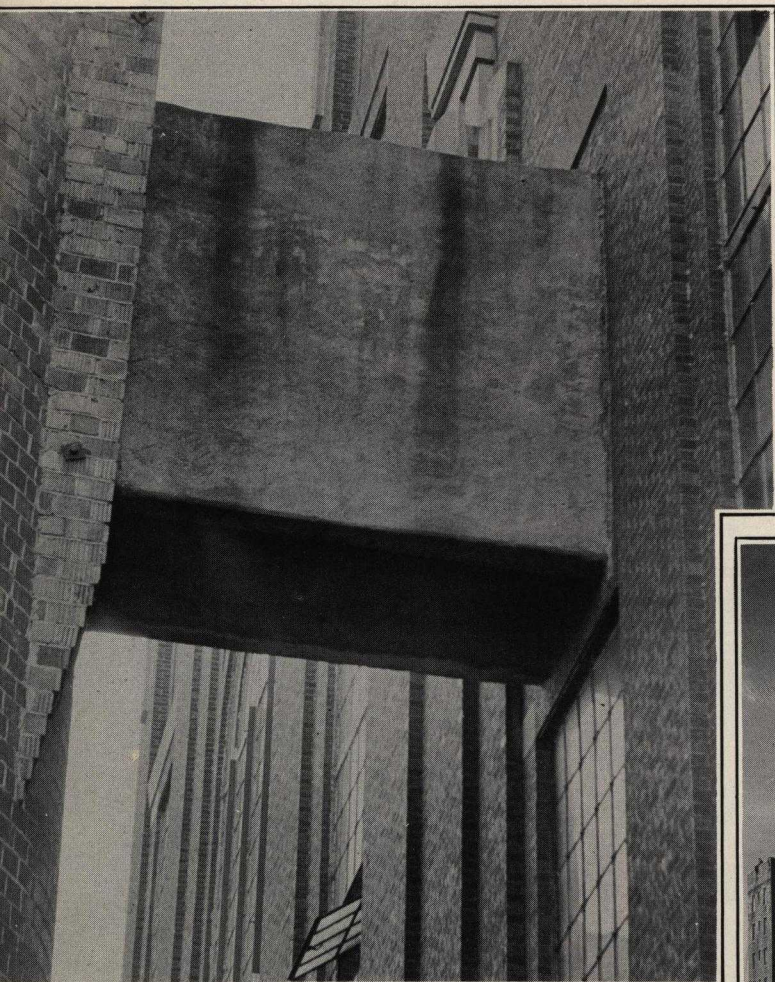
Lorain-Central Viaduct — Cleveland, Ohio — 12,000 cubic yards Hydraulic Haydite used in reinforced concrete deck. Engineers: Wilbur Watson & Associates; General Contractor: Lowensohn Construction Co.

STRUCTURAL CONCRETE Physical Properties

DURABILITY

Resistance to freezing and thawing is equal to, or better than, dense aggregate concrete with or without entrained air.

Illustrating the durability of Haydite concrete when exposed to the natural elements, as well as the action of flue gases, is the breeching at the Elyria Pumping Station, Lorain, Ohio. In the reconstruction of this breeching, some durable type of protection was necessary. Haydite concrete was applied with a cement gun while the plant was in full operation. A one-inch covering was applied directly to the old corroded steel breeching for insulation and was followed by an additional four inches for structural purposes. Temperature at the time of installation was approximately 400° F.



After 20 years of service without spalling, cracking or other signs of weathering, the above-pictured breeching application (Elyria Pumping Station, Lorain, Ohio) illustrates the ability of Haydite to withstand exposure to natural elements.

This Haydite concrete was applied in July, 1932, and when inspected in February, 1952, the breeching showed no signs of cracking or weathering.

THERMAL CONDUCTIVITY

Thermal conductivity of Haydite structural concrete is $\frac{1}{3}$ that of gravel concrete. The "k" value of 3.98 B.T.U. per hour per square foot per inch thickness per degree fahrenheit may be used for calculating heat losses.

Even greater insulating values may be obtained using lean fill mixes. For values of overall coefficients of heat transmission for various wall thicknesses, see Page 11 in the section on insulating concrete.

THERMAL EXPANSION

Coefficient of expansion of Haydite structural concrete is 0.0000042 inches per inch, per degree fahrenheit.

SHRINKAGE

Approximately 0.08% at 70° F. and 55% relative humidity for 100 days. Less than any other type of lightweight aggregate.

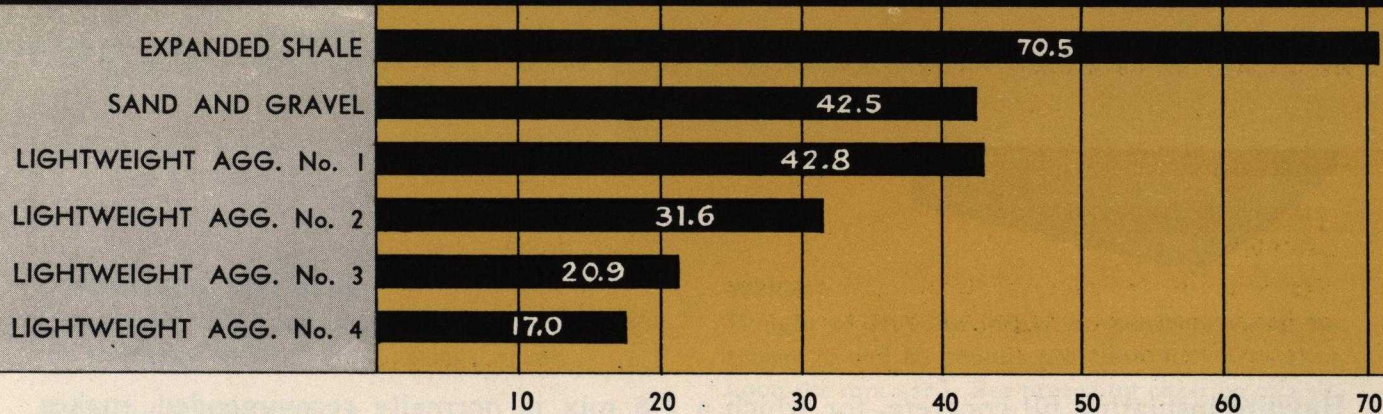
WATER PERMEABILITY

Resistance to rain penetration is excellent. For complete details and test results, see the Building Materials and Structural Report BMS82 issued by the National Bureau of Standards.

Forest Hills Apartments, Cleveland — More than 10,000 cu. yds. of Haydite Structural Concrete for columns, beams and floors. Architects: Weinberg, Laurie & Teare; General Contractor: Shaker Masonry & Concrete Co.



STRENGTH-WEIGHT RATIO — HHFA SOURCE



STRENGTH-WEIGHT RATIO

According to a recent National Bureau of Standards investigation, the strength-weight ratio of expanded shale aggregate concrete (Haydite is the original expanded shale aggregate) exceeds that of any other concrete tested. The above maximum ratios were obtained.

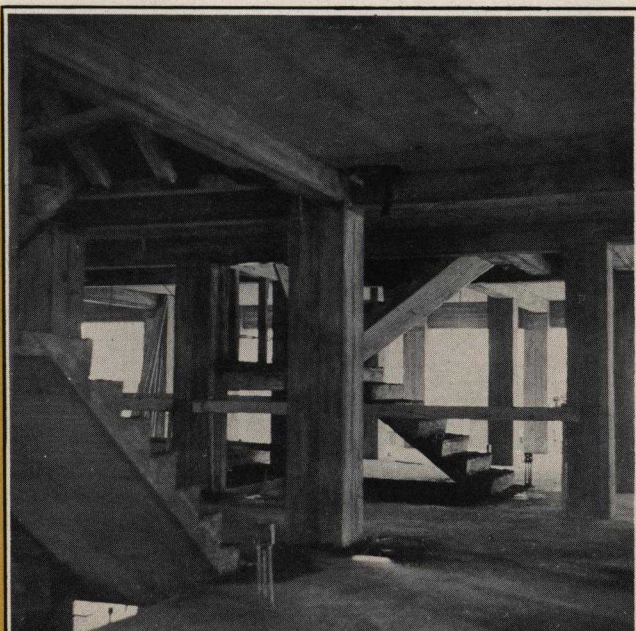
FIRE RESISTANCE

Fire resistance of Haydite concrete has been established by test and repeated experience. In fact, Haydite is widely used in insulating refractory concretes where temperatures up to 2000° F. are encountered.

During the construction of the Ambassador Apartments in St. Louis, a fire burned the forms from the green concrete. To determine the effect of the fire on the Haydite concrete, cores were taken at the spots where the fire and heat were most intense. The age of cores at time of their removal from the building was approximately nine days and the concrete had been subject to freezing

weather for two days before the cores were drilled. The age of the cores at the time of tests was sixteen days. The average compressive strength of the nine cores was 2520 p.s.i. with a range from 2290 to 2780 p.s.i. The report of the testing laboratory stated: "Throughout the fire damaged area there was no sign of fire expansion cracks common to ordinary concrete damaged by fire."

Ambassador Apartments—St. Louis—Lightweight Hydraulic Haydite specified for floors, columns and stairways (see photo below). Architect: I. Shank; General Contractor: Udel Building Co.





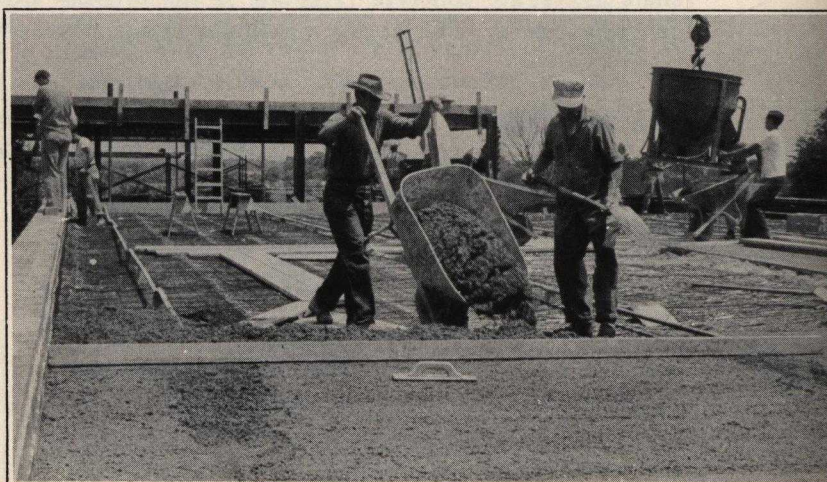
INSULATING CONCRETE produced

Haydite insulating fill concrete, for which a 1-8 mix is normally recommended, makes an excellent insulating concrete for (1) roof and floor fills, (2) insulation under radiant heat floor slabs and (3) for providing saddles and cants on flat roofs. It is not subject to attack by moisture, mildew, termites, etc., which may eventually destroy some insulating materials. Because of high compressive strength of Haydite insulating concrete, it retains its form under conditions of use—thus retaining its effectiveness as an insulating material.

MIX DESIGN

"BX" Haydite may be proportioned based on weight of 1500 pounds per cubic yard. The absorption of the aggregate is 7% by weight. Moisture in excess of 7% will be effective as mixing water. As Haydite absorbs moisture slowly, pre-wetting dry aggregate in advance of mixing is recommended.

The following quantities for one cubic yard of concrete in place are recommended in designing mixes. Using additional mixing water above the amount shown will reduce the yield.



Jefferson Elementary School Addition—Elyria, Ohio—pouring Haydite Insulating Concrete roof fill. Architects: Outcalt, Guenther & Associates; General Contractor: Yates Construction Co.



MIX	MIXING WATER	CEMENT Sacks Per Cu. Yd.	HAYDITE Cu. Yds. Per Cu. Yd. Concrete in Place	WEIGHT Pounds Per Cubic Foot	COMPRESSIVE STRENGTH	
	Gallons Per Sack Cement				Pounds Per Sq. In. 7 Days	28 Days
1-6	5.5	4.5	1.00	80	700	1,200+
1-8	7.0	3.5	1.03	78	600	1,000+
1-10	8.5	2.9	1.06	75	450	800+

with job-proven Hydraulic Haydite

COMPRESSIVE STRENGTH

Please refer to the preceding section on mix design for strengths obtained with various mixes.

THERMAL CONDUCTIVITY

Thermal conductivity of Haydite fill concrete is one-sixth that of natural aggregate concrete. The "K" value of 1.82 may be used for calculating heat losses.

The following chart may be used to determine the comparative values of overall coefficient of heat transmission for various construction materials for different wall thicknesses.

WEIGHT

Weight of Haydite insulation concrete varies between 75 and 80 pounds per cubic foot depending upon the mix used. See preceding chart on mix design for variation in weight with cement content.

DURABILITY

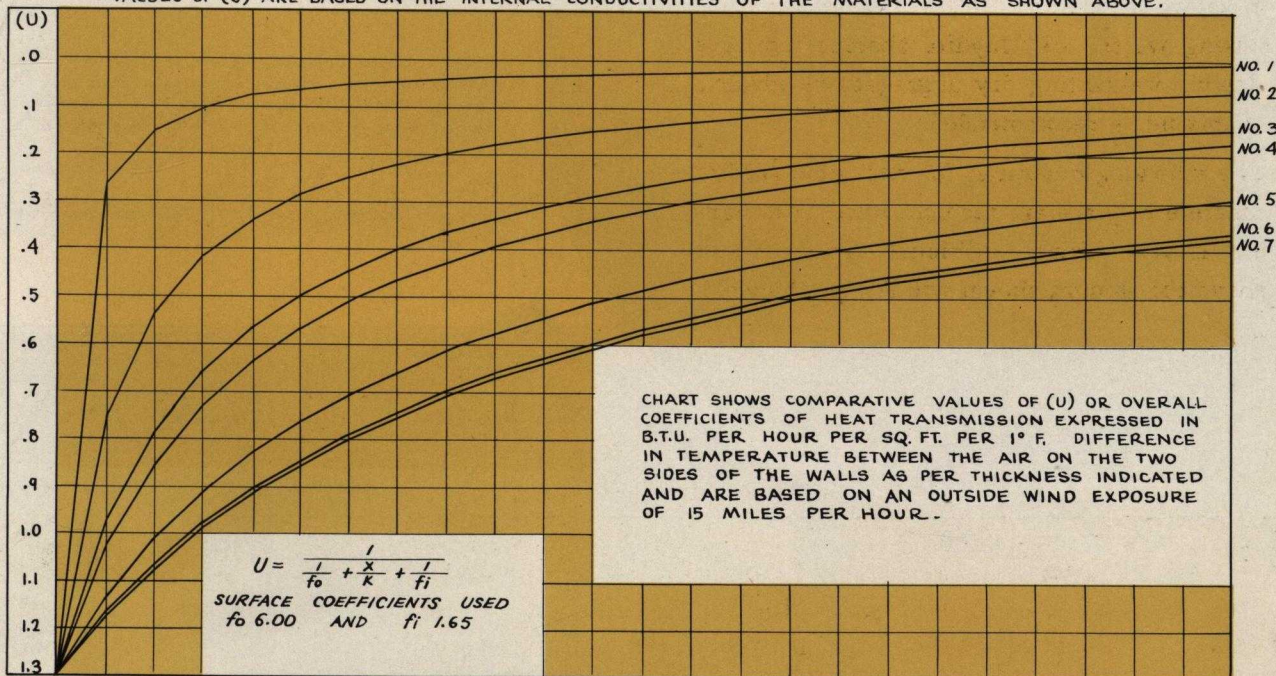
Haydite is chemically inert and free of silt, sulphur and other impurities. Metals, metal piping, conduits, etc. may be safely embedded in Hydraulic Haydite concrete. The complete absence of organic materials in Haydite concrete insures its being rot-proof and vermin-proof.

INSULATION VALUE OF HAYDITE CONCRETE COMPARED TO VARIOUS OTHER MATERIALS HYDRAULIC LIGHTWEIGHT HAYDITE CONCRETE AGGREGATE

CONDUCTIVITY OR VALUE OF K EXPRESSED IN B.T.U. PER HOUR PER SQ. FT. PER 1-INCH THICKNESS PER 1° F. DIFFERENCE

NO. 1	CORKBOARD-FLAX-LI-NUM-INSO-BOARD-MASONITE-CELOTEX-ETC.	K = 0.33
NO. 2	HAYDITE INSULATING FLOOR AND ROOF FILL.	65# TO 75# PER CU. FT. K = 1.82
NO. 3	HAYDITE STRUCTURAL CONCRETE	94# TO 100# PER CU. FT. K = 3.98
NO. 4	COMMON BRICK BACKUP,	120# TO 125# PER CU. FT. K = 5.00
NO. 5	FACE BRICK.	120# TO 125# PER CU. FT. K = 9.20
NO. 6	CONCRETE SAND AND STONE AGGREGATE.	146# TO 150# PER CU. FT. K = 12.00
NO. 7	STONE-SLATE-MARBLE.	150# TO 160# PER CU. FT. K = 12.50

VALUES OF (U) ARE BASED ON THE INTERNAL CONDUCTIVITIES OF THE MATERIALS AS SHOWN ABOVE.



WALL THICKNESS	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"	13"	14"	15"	16"	17"	18"	19"	20"	21"	22"	23"	24"
NO. 1	.2629	.1463	.1013	.0775	.0627	.0527	.0454	.0399	.0356	.0321	.0293	.0269	.0248	.0231	.0216	.0203	.0191	.0180	.0171	.0162	.0155	.0148	.0141	.0136
NO. 2	.7563	.5393	.4130	.3366	.2840	.2457	.2165	.1934	.1748	.1595	.1467	.1357	.1263	.1181	.1109	.1045	.0988	.0937	.0891	.0850	.0812	.0777	.0745	.0716
NO. 3	.9766	.7841	.6551	.5625	.4928	.4385	.3950	.3593	.3295	.3043	.2827	.2640	.2475	.2330	.2201	.2086	.1982	.1888	.1802	.1724	.1653	.1587	.1526	.1469
NO. 4	1.0280	.8527	.7284	.6358	.5641	.5069	.4602	.4214	.3886	.3606	.3363	.3151	.2964	.2798	.2650	.2517	.2396	.2286	.2186	.2095	.2010	.1933	.1861	.1794
NO. 5	1.1346	1.0101	.9101	.8282	.7597	.7018	.6521	.6089	.5711	.5377	.5080	.4814	.4575	.4358	.4161	.3981	.3816	.3664	.3523	.3393	.3273	.3160	.3055	.2957
NO. 6	1.1682	1.0646	.9778	.9041	.8408	.7857	.7374	.6947	.6567	.6226	.5919	.5641	.5387	.5156	.4943	.4748	.4567	.4400	.4244	.4099	.3964	.3837	.3718	.3606
NO. 7	1.1727	1.0721	.9874	.9151	.8527	.7982	.7503	.7078	.6699	.6358	.6050	.5771	.5516	.5283	.5069	.4871	.4688	.4519	.4361	.4214	.4077	.3948	.3827	.3713

TYPICAL INSTALLATIONS

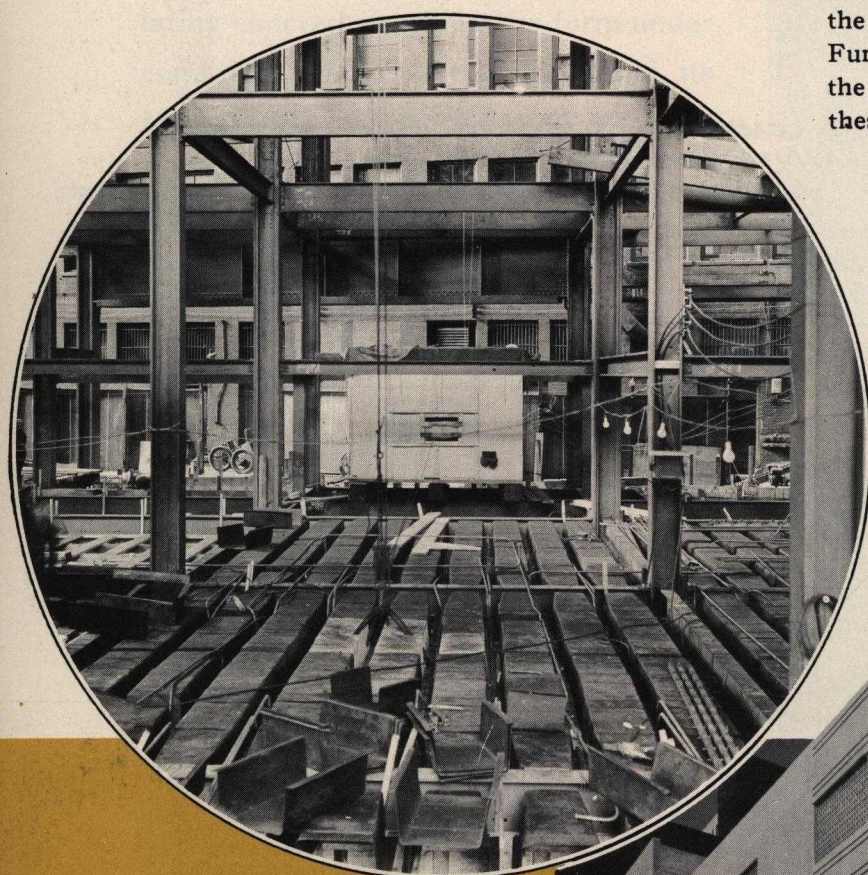
ROOF INSULATION

Haydite concrete roof insulation is used over structural concrete decks, Haydite roof tile decks, steel roof decks and corrugated iron or asbestos. Cants, crickets and saddles may be poured monolithically with the roof insulation. Desired slopes for roof drainage can be obtained by varying the thickness of the Haydite concrete. Built-up roofing is applied directly to the Haydite concrete because it makes an ideal bonding surface.

CONCRETE FLOOR INSULATION

Use of Haydite insulating concrete under floors containing pipes or ducts for radiant heating greatly reduces heat losses to the ground. The pipe or ducts should be imbedded in natural aggregate concrete because of its greater heat conductivity.

Haydite insulating concrete used under unheated concrete slabs will reduce heat losses from the slab. Thus the floor temperature will more closely approximate the temperature of the air above the slab. It will also protect the concrete from condensation in warm, humid weather by insulating the slab from the cooler ground temperatures. Furthermore, using Haydite structural concrete for the slab proper will greatly aid in accomplishing these results.

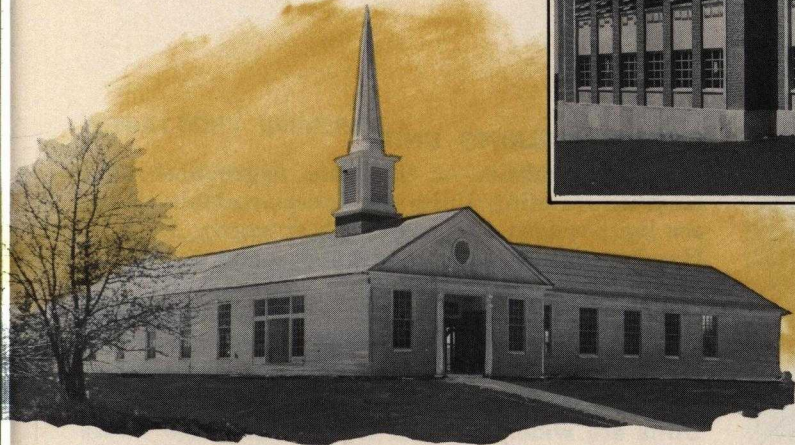


Halle Brothers Company—Cleveland, Ohio—
9,000 cubic yards Hydraulic Haydite Structural
Concrete for all 10 floors. Architects: Walker and
Weeks; General Contractor: Sam W. Emerson Co.

Stix, Baer & Fuller Parking Garage—
St. Louis—Floors and ramps utilize Hydraulic
Haydite Structural Concrete. Architects:
Russell, Mullgardt & Schwarz;
General Contractor: H. B. Deal & Co., Inc.

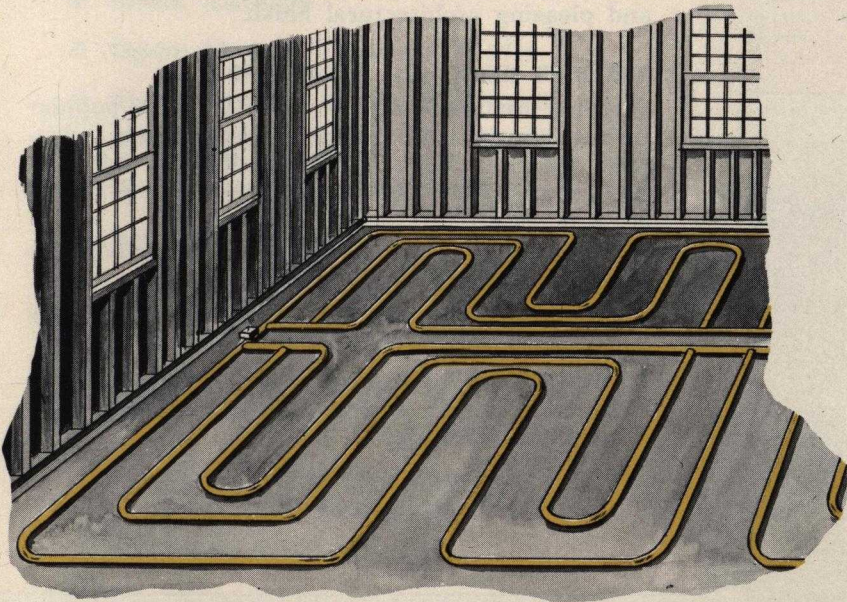


Brown Shoe Company—Clayton, Mo.—Here Hydraulic Haydite is used for floor fill. Architects: Russell, Mullgardt & Schwarz; General Contractor: Frazier Davis Construction Co.



FLOOR FILL IN MULTIPLE STORY CONSTRUCTION

Haydite concrete is easily controlled to give the desired densities and strengths. Regular concrete equipment and operators familiar with regular concrete practices can *handle Haydite concrete without special precautions or supervision*. Haydite floors not only withstand heavy equipment without being compressed or crushed, but also eliminate the need for any special topping to distribute superimposed loads (prevent settling of furniture, etc.).

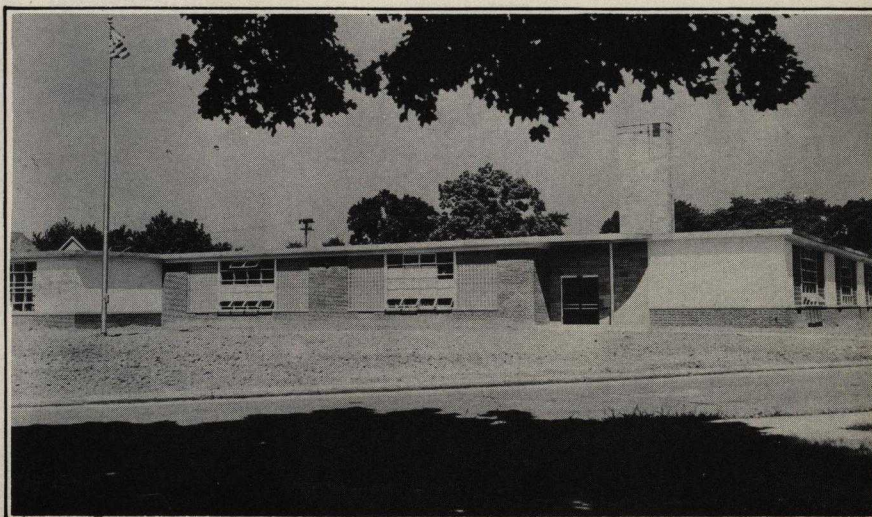


Trinity Congregational Church—Cleveland—6,000 square feet floor area with radiant heating system placed on Hydraulic Haydite. Architects: Ward and Conrad; General Contractor: Humel Construction, Inc.

13

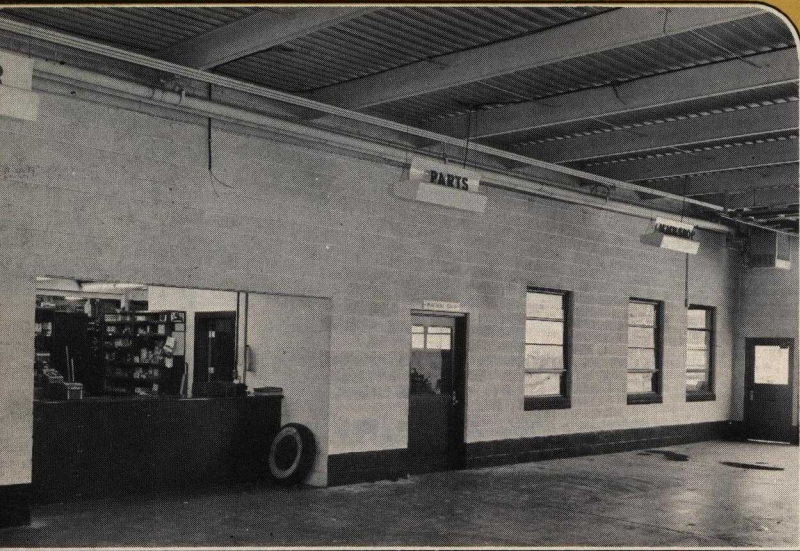


Telling-Belle Vernon Office—Cleveland—40,000 Hydraulic Haydite Building Units for backup and partitions; Haydite Concrete for lightweight insulating floor—roof fill. Architects: Christian, Schwarzenberg & Gaede; General Contractor: Sam W. Emerson Co.



Valley View School—Cleveland, Ohio—Hydraulic Haydite Building Units provide exposed interiors and exteriors. Architect: Arthur F. Baer, Cleveland Board of Education; General Contractor: H. E. Klefman Co.

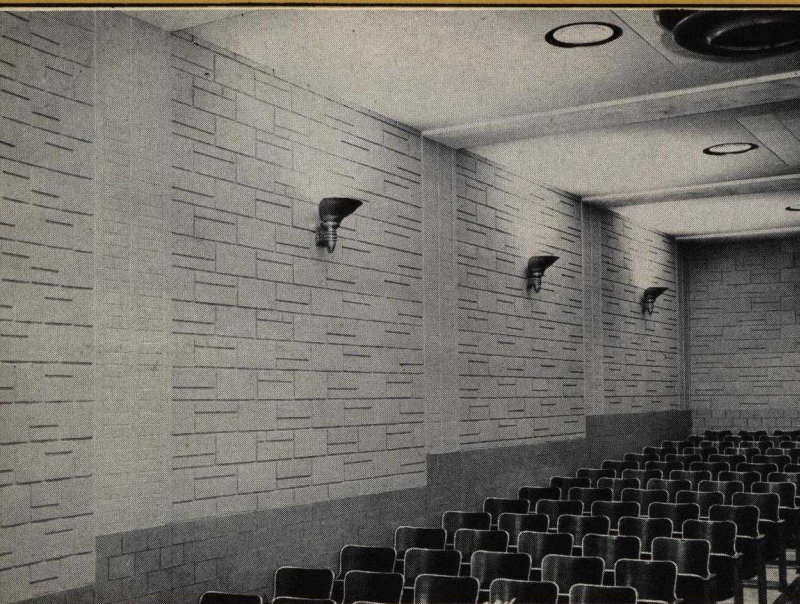
plus THESE ADDITIONAL USES FOR Hydraulic *adapted to today's*



Laman Motors, Inc.—Cleveland, Ohio—Architect: Jules Schwartz; General Contractor: The L. H. Bailer Co., Inc.



Central Police Station—Columbus, Ohio—Hydraulic Haydite Building Units for backup and partitions. Architects: Allied Architects' Association.



Auditorium, Gracemont School—Cleveland, Ohio—Exposed Haydite interior. Architect: Arthur Baer, Cleveland Board of Education; General Contractor: Leo W. Schmidt Co.

HAYDITE BUILDING UNITS

Superior qualities of Haydite aggregate make Haydite Building Units the finest available. They are light-weight and have high strength. Because Haydite is chemically inert and contains no foreign matter, it eliminates staining, discoloration and pop-outs. Sound and thermal insulating properties are outstanding as proven in the laboratory and in actual use.

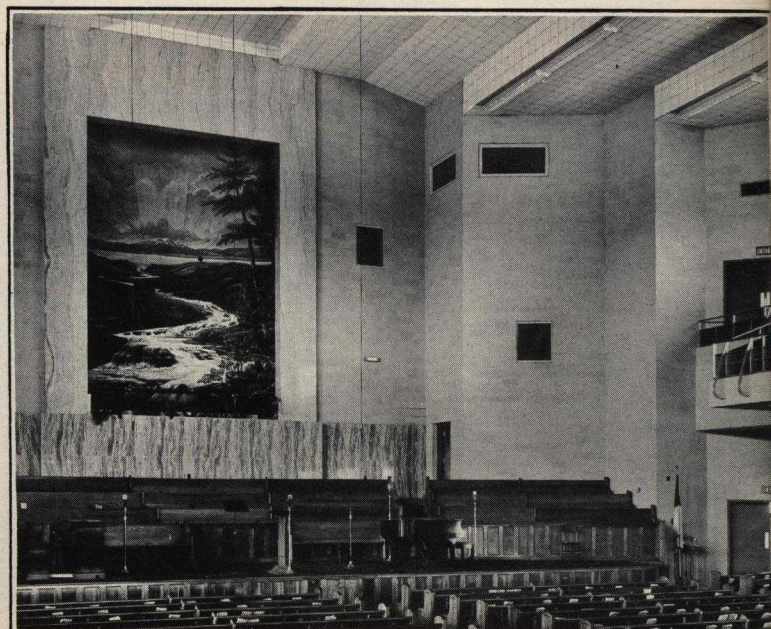
In addition to exterior work, Haydite Building Units are widely used in exposed interiors where their uniform open texture provides a practical and pleasing architectural finish.

PRE-CAST CONCRETE ROOF SLABS

Haydite pre-cast concrete roof decks are popular throughout the United States and Canada in industrial plants, schools, public buildings, hangars, garages and other buildings. Among the principal advantages are:

- Permanence — not affected by heat, moisture condensation, steam or gases.
- Fire resistance is excellent as illustrated by extensive use in refractory concrete.
- Ideal base for any roofing material.
- Erection is fast, saving time and speeding construction schedules.

14



Sanctuary, Akron Baptist Tabernacle—Akron, Ohio—Hydraulic Haydite Building Units for exposed interiors. Architect: Tretton Sagadencky; General Contractor: A. R. Chilton.

Haydite.. "the Original" Lightweight Aggregate

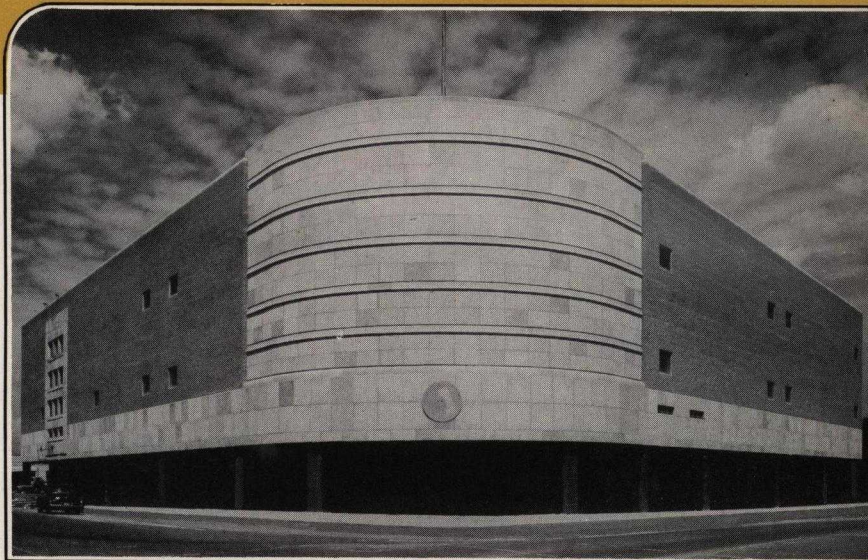
modern construction

REFRACTORY CONCRETE

Use of Haydite aggregate provides an insulating refractory concrete with structural properties. The resistance to crushing loads actually increases after the transition from hydraulic to ceramic bond at high temperatures. For Gunit applications, a special finer gradation is supplied. Among these uses are:

- Jet Engine Test Cells
- Stack Linings
- Open Hearth Furnace Walls
- Blast Furnace Stoves—Ringwall and Dome
- Blast Furnace Downcomers
- Boiler Walls
- Insulating Firebrick
- Heat Resistant Foundations
- Sheet Steel Annealing Buggies

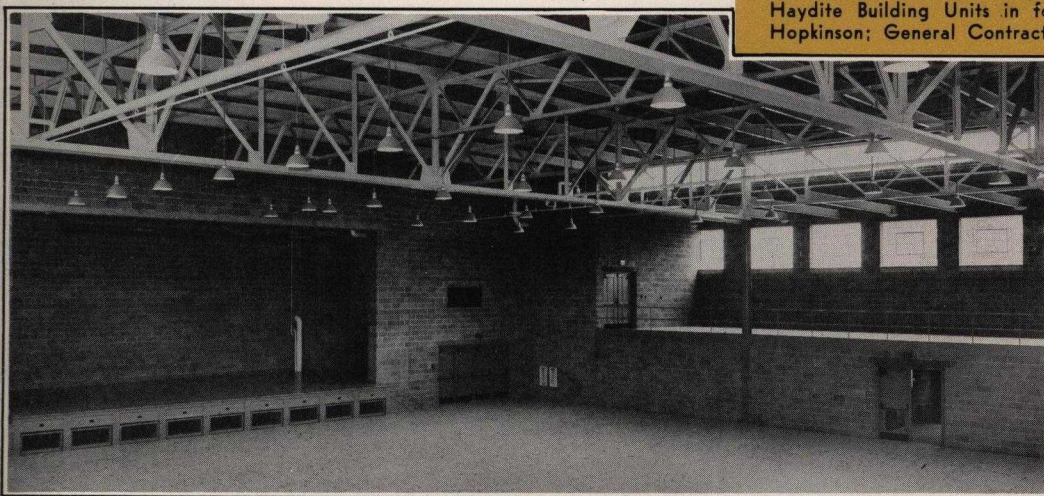
For further information regarding the many uses of Hydraulic Haydite, write or phone now!



Famous-Barr Company Southtown Store—St. Louis—50,000 Hydraulic Haydite Building Units and 5,000 cubic yards Haydite Structural Concrete. Architects: P. John Hoener & Associates; General Contractor: Westlake Construction Co.



West Side Masonic Temple—Cleveland—80,000 8-inch and 12-inch Hydraulic Haydite Building Units in foundation, backup and partitions. Architect: Charles Hopkinson; General Contractor: Gilmore, Carmichael, Olson Co.



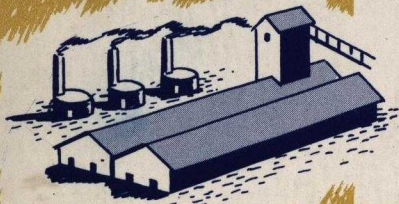
Gymnasium, Groveport School—Groveport, Ohio—Abuse-proof, attractive Hydraulic Haydite Building Units for interior and Haydite precast roof slabs. Architect: Frank Glass, Columbus; General Contractor: George Sheaf & Co.

HYDRAULIC-PRESS BRICK COMPANY

St. Louis, Mo.

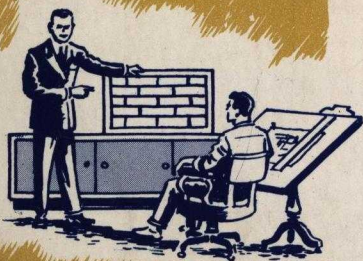
South Park, Ohio

PRODUCTS



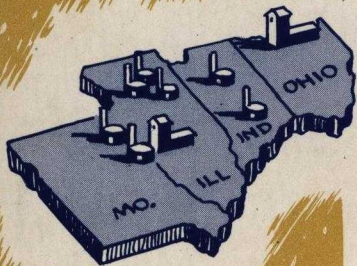
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